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the pleasure and information it has given to those who are enthusiasts already and who have been privileged to study it.

The Harvard College Observatory (Professor E. C. PICKERING, Director), has sent to the Fair an interesting and important exhibit of photographs and engravings which illustrate its long and honorable history, and which show the progress of the great works now being carried on in both hemispheres in photography, photometry and in spectroscopy. The exhibit is well displayed in a large room adjacent to the space occupied by the LICK Observatory.

The Physical Laboratory of the JOHNS HOPKINS University also occupies an adjacent space with an exhibit of the magnificent spectrum maps made by Professor ROWLAND. One of ROWLAND'S concave diffraction gratings forms a part of the exhibit and is so displayed as to project the spectrum of the Sun by day and of the electric arc lights by night.

(FIFTEENTH) AWARD OF THE DONOHOE COMET-MEDAL.

The Comet Medal of the Astronomical Society of the Pacific has been awarded to W. F. DENNING, Esq., F. R. A. S., of Bristol, England, for his discovery of an unexpected comet on March 26, 1894.

The Committee on the Comet-Medal,

EDWARD S. HOLDEN,
J. M. SCHAEBERLE,
CHAS. BURCKHALTER.

May 26, 1894.

ON THE FORMS OF THE DISKS OF *JUPITER'S* SATELLITES.*

The contradictory results obtained by different observers of *Jupiter's* satellites seem to indicate that with our present instrumental means it may be impossible to decide definitely the exact form of celestial bodies presenting very small disks. The evidence seems to prove that the unavoidable errors of judgment in different conscientious observers are often due to radically different causes. Just how these different errors are produced is not clear, but that some of the observers are wrong the discordances in the results prove.

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* Reprinted from the *Astronomical Journal.*

The case of *Jupiter's* first satellite furnishes a good example. In a careful series of observations of this body made with the special purpose of determining the form of the disk, Professor BARNARD, with one single exception, recorded the satellite as circular in outline on eighteen different occasions.† To Professor CAMPBELL and myself the satellite appears round only when it is very near to or projected on the disk of *Jupiter*, and elongated in the direction of the planet's equator in all other positions.‡ Professor HOLDEN likewise satisfied himself during our observations that the disk of I was elliptical and that of III round, when the satellites were off the disk. Professor W. H. PICKERING on the other hand observed regular periodic changes of such a nature that the interval of time between a circular phase and the next following (or preceding) maximum elliptical phase was only about six and one-half hours.§ These last mentioned observations were made at Arequipa and have not been verified elsewhere.

As an illustration of my own observations of Satellite I, made near its western elongation for the special purpose of detecting a rapid change of phase, the results of a series of measures of the major and minor axes of the elliptical disks as drawn by me on December 9, 1893, are here given:

Mount Hamilton P. S. T. of Drawing. H. M.	Ratio of the Diameters.
8 40	0.84
9 35	0.86
11 25	0.83
12 10	0.80
13 20	0.83
14 20 *Note:* No drawing.	(0.83) Same as at 13^h 20^m.

It will be seen that during a continuous interval of 5^h 40^m, my observations gave a practically constant form for the outline; during this time all the other satellites appeared nearly round.

As bearing directly upon the Arequipa satellite observations, a significant fact, apparently showing the great superiority of the Mount Hamilton results over those obtained by Professor W. H. PICKERING, will now be briefly considered.

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† *Astronomy and Astro-Physics* for April, 1894, page 272.

‡ *Publications* of the A. S. P., 1891, Vol. III, page 355.

§ *Astronomy and Astro-Physics* for May, 1893, page 390.

In a paper,[*] published in No. 305 of the *Astronomical Journal*, I proved that the apparently abnormal forms of the shadows which I repeatedly observed here, and which had at diverse times been observed by others, were not abnormal at all but required by theory. The past literature of this subject reveals the fact that some of the ablest astronomers must at times have regarded the shadows as round when, as the theory will prove, they were very far from being so. So strongly has the heretofore generally received idea—that the shadows as viewed from the earth should always be practically circular—influenced the judgment of observers in general, that the comparatively few records describing the true form of the shadow when it was not round, have been regarded with more or less doubt, at times even by the actual observers of the phenomenon.

Now one would naturally suppose than an observer, after having discovered, as he believed, a periodic variation in the form of a satellite, would seek to verify his results by examinations of the satellite's shadow during its transit across the disk of the planet. Taking the January, 1893, observations of Satellite I as observed at Arequipa, I find that the longest (longitudinal) diameter of every shadow just after its ingress on the visible disk of *Jupiter* was more than twice the breadth of the shadow, while at egress just the reverse condition of things existed. That this enormous distortion escaped the scrutiny of the Arequipa observers seems to be shown by the published evidence, for nowhere, so far as I know, does it appear that the repeatedly distorted shadow outlines were ever observed at Arequipa. At the LICK Observatory on the other hand, the systematic recurrences of the various phenomena during the shadow's transit were so persistently observed by myself that they led to the discovery of the true explanation.

J. M. SCHAEBERLE.

LICK OBSERVATORY, June 9, 1894.

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[*] A Simple Geometrical Explanation of the Cause of the Observed Distortions of the Shadows of *Jupiter's* Satellites.